Information for travelling: Awareness and usage of the various sources of information available to public transport users in NSW.

Corinne Mulley1, Geoffrey Tilden Clifton1, Camila Balbontin1, Liang Ma1

1Institute of Transport and Logistics Studies, The University of Sydney Business School, Building H73, THE UNIVERSITY OF SYDNEY NSW 2006

Email for correspondence: corinne.mulley@sydney.edu.au

Abstract

Public transport authorities and service providers place great emphasis on information provision to travellers both before and during travel. Information provided prior to travel has included printed timetables, newspaper advertisements, telephone services and marketing campaigns. During the trip, providers have tended to offer maps at public transport stops (i.e. bus stops, train stations, ferry wharves, etc.) as well as timetables static, dynamic or real-time.

Some of these channels are still used but improvements in digital technology has led to a wider range of information distributed using different digital media. Whilst Transport for NSW and transport operators continue to provide the more traditional information, there has been a plethora of third party applications which are accessible on the move.

The literature recognises that the need for information and the importance of information provision differs at the various stages of the trip, from planning, to entry into the system, to wayfinding during the trip and egress from the system. However, no systematic research exists as to how information preferences and usage differ between customer segments. It is important for operators and regulators to identify the segments and their information preferences so as to promote public transport use.

This paper addresses this important issue by presenting the results of an internet survey of the public’s awareness and usage of public transport information. The paper looks at awareness and usage of information sources and how this varies by stage of journey and frequency of usage of public transport. Factor analysis is used to identify segments of customers by attitudes towards public transport and usage of information sources. These results are used to model how these factors relate to overall satisfaction with public transport journeys. The paper provides a reference for other states in Australia as to the value of different types of information.

1. Introduction

Public transport information provision can be considered essential for informing potential travellers about the options available to them. Information is also essential for informing public transport users prior to their trips about the timings and options available to them as well as to help users anticipate or overcome disruptions during their travel. Users may also require information on how to reach their ultimate destination after arriving at their final bus stop or railway station, particularly where a trip is not part of their regular routine.

Sources of information can be divided into two types: Formal information provided by public transport operators or government authorities such as Transport for NSW and informal information provided by acquaintances, other public transport users or a traveller’s own personal experience. The traditional sources of formal public transport information are fading in importance as operators reduce the availability of printed timetables. Simultaneously, social media is playing an increasingly important role as both formal and informal sources of public transport information (Papangelis et al. 2016). Furthermore, hybrid forms such as privately created apps that rely on official timetable information are also increasing in prominence.

This paper looks at what sources of information are being used in Sydney and how this varies by frequency of transport usage and stage of journey. The paper also estimates the relationship between the use of these information sources and overall satisfaction with the public transport journey. The aim is to identify whether information preferences and usage differ between customer segments and at different stages of the journey as an evidence base for operators and regulators to identify such segments and their information needs so as to promote public transport use. The success of information provision was measured in two ways, first by the overall satisfaction with the public transport trip to see how important information was in the overall picture and secondly by the overall satisfaction of information provision for the trip to focus in more specifically on information. This research adds to the literature on the soft factors (which include information provision) by providing a more nuanced look at the sources of information used and their importance.

The paper is structured as follows. The next section provides context for this paper in terms of the Sydney Metropolitan area and recent developments in information provision in the Sydney Public Transport system. Section 3 places examines the academic literature on information provision and usage within the broader literature on soft factors and identifies some relevant research questions. Section 4 discusses the survey that was run to gather data on how Sydney residents use public transport information and the methodology for the modelling work undertaken. The survey results on awareness and usage of public transport information are presented in Section 5. Section 6 shows the factor analysis used to detect different travel attitudes. Section 7 presents the modelling technique used, which includes the results of the factor analysis and Section 8 the results of the models. Section 9 discusses the main conclusions of this study as well as the limitations and areas for future research.

2. The Sydney Context

This paper has chosen to use the Greater Sydney Metropolitan region as the study area with the internet survey only open to residents of this region. Section 2.1 describes the study area whilst Section 2.2 provides context for this paper by discussing recent developments in public transport information provision in Sydney.

2.1. Description of study area

Table 1 provides a summary of the passenger transport task in the Greater Sydney Metropolitan region which has an estimated population of 4,921,000 at July 2015 (ABS 2016). In 2011, 12.1 per cent of households in this region did not have a motor vehicle (ABS 2013) which is a greater proportion of households than Greater Melbourne (9.1 per cent) or Australia as a whole (8.6 per cent). As a result Sydney has a higher reliance on public transport than other Australian metropolitan areas.

Table 1 shows that bus and heavy rail networks are of equal importance in terms of the number of passengers carried but rail is more important on a passenger kilometre basis reflecting the longer average travel distances for rail.

Table 1: Transport usage in Sydney for 2013

|  |  |
| --- | --- |
|  | Sydney |
| Metropolitan population | 4757.1 |
| Total trips by public transport (millions) | 635.4 |
| Of which heavy rail | 306.2 |
| Of which bus | 307.1 |
| Car passenger kilometres (billions) | 45.7 |
| Public transport trips per person | 133.6 |
| Of which heavy rail | 64.4 |
| Of which bus | 64.6 |
| Car passenger kilometres per person | 9613.0 |
| Public transport kilometres per person | 1723.5 |
| Of which heavy rail | 1158.3 |
| Of which bus | 531.8 |
| Public transport average trip length (kilometres) | 12.9 |
| Heavy rail average trip length (kilometres) | 18.0 |
| Bus average trip length (kilometres) | 8.2 |

Source: Australian Government (2014)

2.2. Recent developments in public transport information provision in Sydney

Until the early 1980s, the formal provision of public transport information relied on word of mouth from employees and printed timetables in the form of leaflets, timetable books (e.g. PTC 1978) or timetable posters at stations and stops. The Urban Transport Authority (UTA) was created in 1980 to run government bus services in the inner cities of Sydney and Newcastle, to manage private bus services in other parts of Sydney and to work with the government passenger rail operator on information provision. The UTA introduced standardised designs for printed timetables that included route maps and developed multimodal public transport information in the form of network maps and the Metro Trips telephone information service (UTA 1986).

Route maps and timetable information has been mandatory at all bus stops serviced by the government bus operator since at least the 1990s (STA 1999, p. 34). Network maps and timetables were also mandatory at all railway stations. Bus stops serviced by private operators were less well provisioned with bus stop signage only becoming mandatory in the last five years and no requirement for provision of timetables or maps as shown in the left hand top picture of Figure 1.

Since 2000 the internet has gained popularity as a source of information with both governments, operators and users. Currently the range of sources of information include the website of Transport for NSW (the government agency responsible for regulating the public transport network whose website for public transport information is <http://www.transportnsw.info/>), operator websites (e.g. [www.hillsbus.com.au](http://www.hillsbus.com.au)), real time transport apps (e.g. TripView) or social media in the form of Twitter and Facebook.

Figure 1: Examples of recent NSW bus stop design

|  |  |
| --- | --- |
| C:\Users\geoffreyc\Desktop\IMG_3315.JPG | C:\Users\geoffreyc\Desktop\IMG_3320.JPG |
| Bus stop signage for a privately operated bus service installed in 2011 to the then current standard. Note the unused space for including the bus stop number to be used to look up timetable information | Bus stop signage installed in 2016 to the current Transport for NSW standards for a major bus stop |
| N:\ITLS\PT-Team\Project - Information for travelling\IMG_3352.JPG |  |
| Timetable signage in Sydney’s CBD during Light Rail construction |  |

Picture sources: Author’s own pictures, June 2016.

The latest designs for major bus stops signage apply to both private and government run bus services and include printed timetables and stylised network maps as shown in the right hand picture of Figure 1. However, the NSW government is so confident in the ubiquitousness of the new internet and mobile based information sources that they have started to replace printed timetable posters at railway stations with posters advertising the various real time transport apps. Although timetable leaflets are still printed for all transport modes they are not as widely distributed as before and printed multimodal network maps are not available for some areas.

This section has provided the context for the study area for the survey of travellers’ usage and perceptions of information provision. The next section provides the academic literature context for the survey and identifies the gaps in the literature on this topic and the research questions to be examined in this paper.

3. Literature review

Public authorities and researchers are constantly seeking ways to improve public transport. Numerous transportation studies have enriched the knowledge on the way public transportation operates and how it influences individuals’ behaviour at the time of choosing a mode of transport. Discrete choice model studies traditionally considered only the attributes that directly depended on the mode of transportation as influencing decisions, often referred to as ‘hard factors’, such as travel time, frequency, fare, etc. However, several studies have shown that when reaching a decision individuals also consider other attributes that do not necessarily depend on the mode of transportation (Hickman & Wilson, 1995; Paulley et al., 2006; Lai & Chen, 2011). These attributes have been referred to in literature as ‘soft factors’.

Soft factors studies mostly consider varied indicators that might influence travel behaviour decision and the role of information is generally included in this category. Soft factors however cover a much wider range of factors influencing travel behaviour including the quality of the access and waiting experience (Guo et al, 2007; Streeting and Barlow, 2007; Mulley et al, 2014), quality of the in-vehicle experience (Wardman and Whelan, 2011; Currie and Wallis, 2008 and Hensher, 2011), fare structure and ticketing system (Wardman and Hine, 2000; Litman, 2014; Graham and Mulley, 2012) and safety and security (Nelthorp and Jopson, 2004 and Cooper et al, 2007). In this study we are interested in the specific soft factor of information provision.

The indicators for information provision vary between studies and can usually be defined using two categories: the time of the trip where the information is provided (prior, during, or after) and source of information provided (printed maps, printed timetables, real-time data information of arrival times, etc.). Alongside this the literature currently available on soft factors in public transport can be grouped into the following categories: identifying the influence of soft factors on behaviour; estimating a public transport quality measure; users’ perception on soft factors; and willingness to pay estimates (WTP) for soft factors.

3.1. Influence of information provision on behaviour

Several studies have shown the importance of information provision in behaviour. Dziekan & Kottenhoff (2007) study the influence of real-time information displays of the next departure of trains and buses at stations and stops in Netherlands on travellers. They carry out two studies: the first one concludes that the perceived waiting times can be reduced by 20 per cent on a tramline when incorporating real-time data displays; and the second one shows that a larger percentage of individuals ran towards their train when real-time information displays were available in a subway station. Guo (2011) studies the influence of having tube maps in London’s subway (London Underground) on travellers’ behaviour and results show that it does affect travellers’ path choices. Ferris et al. (2010) and Watkins et al. (2011) study the influence of a real time information app called OneBusAway in Seattle. Both studies show a significant influence on waiting times and perceived waiting times.

3.2. Public transport quality measures and their effect on travel behaviour

A number of studies have considered these soft factors as a way of estimating the quality of public transport. In this context, Nathanail (2008) develops a framework to estimate the quality of services provided to passengers on a railway in Greece. They take into account other soft factors (i.e. comfort, servicing and cleanliness) together with information provision. The information provision indicator considered information during trip (e.g. train arrivals), information at station (e.g. train departures announcements, information provided in bulletin board – whether they are electronic or not) and pre-trip information (e.g. availability of information provided at the stations in printed format). Their results show that all the soft factors considered were relevant to passengers, and that they graded the information currently provided poorly. Hensher et al. (2003) carry out a similar study where they develop a service quality index of commercial bus contracts in NSW, Australia. They include several hard and soft factors; regarding information provision they only include information at bus stop with three levels: (1) timetable and map; (2) timetable and no map; and (2) none. They used a nested model where each branch represents one in 9 geographical segments and their results show that having no timetable or map was only significant in one geographical segment.

3.3. Perception on soft factors

Numerous transportation studies have focused on understanding perception on soft factors. This is important to identify if there is a distinction between perception and fact and how this might affect the provision of information.

Eboli & Mazzulla (2011) study users’ perception through estimating a subjective and objective measure for several soft factors on a bus line in Italy. As the information provision indicator they included availability of schedule/maps on bus and at stops. Their results show that the perceived value for information on bus was significantly worse than the objective measure, and for information of stops both subjective and objective measures were very low.

Grotenhuis et al. (2007) identify customers’ desired quality on integrated multimodal information in Netherlands. They consider that desired quality can vary throughout a trip, so they include prior and during trip information. In both situations different types of information users might need are presented, such as map with all the routes, quickest route, all interchanges, among others. Their results show users prefer to have information prior to their trip (as opposed to during) when planning a multimodal travel, and the information needed concerns the part of their trip made by public transport.

Tyrinopoulos & Antoniou (2008) carried out a survey in four lines that had different operators in Greece (bus, trolley bus and rail/metro). They asked their users how important different attributes are to them, and how they would rank the service with respect to that attribute. They included different soft factors, such as driver behaviour, cleanliness, waiting conditions, among others. As an information provision indicator they asked about schedule and transfers information. They conducted ordered logit models and their results showed service frequency, vehicle cleanliness, waiting conditions, transfer distance and network coverage were the most important attributes for passengers’ satisfaction.

Hensher et al. (2010) identify the service attributes that positively influence the perceived overall experience on a bus line in England. They include several soft factors, such as frequency, personal security, reliability, cleanliness, etc. Regarding information provision their survey included ‘information at bus stops’ and ‘finding information about bus routes (how important are to you)’. They interviewed passengers in the routes that had been significantly improved (including improvements on ‘soft factors’), and also passengers in other routes. They estimated ordered logit models and concluded that the greatest potential could be obtained by first increasing the frequency and then by enhancing personal security on the bus. They mention an existent relation between frequency and information provision, where a higher frequency would reduce the demand for information.

Horold et al. (2015) carry out a qualitative study on the acceptance of information displays at stop points. They consider paper based information and public displays in their survey, which was responded by usual travellers, commuters, casual users and tourists. Their results show that when individuals were not familiar with the place, they spent more time searching for information. Moreover, almost 40 per cent of the respondents said that they do not want to plan their journeys at stop points and this is an important feature to take into account when providing information for travellers.

Politis et al. (2010) estimate a perceived value for the provision of real time information to users of public transport in Greece. The source of information for this study comprises in-vehicle variable message signs, in-vehicle sound messages for next stop announcement, and displays of arrivals for the next buses on bus stops. The perceived value for this information provision was estimated relative to the fare of public transport: what percentage of the total fare did travellers believe correspond to these systems. Hence, this perceived value was estimated for the three information sources altogether. They conclude that travellers believe that almost 40 per cent of their cost per trip corresponds to real time information systems.

This section demonstrates that there is a systematic asymmetry between perception and fact in relation to soft factors in public transport. This asymmetry needs to be taken into account in the design of a survey to elicit the different information requirements at different stages of a journey.

3.4. Willingness to Pay (WTP) for soft factors

Finally, a number of transportation studies on soft factors have focused on the estimation of willingness to pay (WTP) for information provision. Molin & Timmermans (2006) estimate the relative importance that recreational travellers[[1]](#footnote-1) assign to information aspects in England, Finland and Netherlands. Their results show that travellers are willing to pay for information systems if they provide additional functionality such as real-time information, or additional trip planning options. This study is interesting since it considers three different sources of information: internet, telephone service and others; and eight different types of information: about tickets (e.g. ticket office), interchange, real time information, private transport, walking route, destination (e.g. tourist, hotel, etc.), on board comfort and service (e.g. if there are toilets, luggage space, etc.), and planning options (e.g. cheapest route). From all the types of information, their study shows that the ones with highest importance are real time information, planning options, tickets, walking route and interchange. Khattak et al. (2003) studies the WTP for better quality information from a traveller advisory telephone system in San Francisco Bay Area. Their results show that a higher WTP are associated with customized travel information, longer trips, work trips and listening to radio traffic reports.

Bray et al. (2011) study transport policies in Australia, and refer to the information provision in road network as deficient in previous years but now gaining importance. Transport for NSW published willingness to pay figures for quality attributes in 2013 (NSW, 2013) where they state the WTP for on-board information and announcement is AUD $0.04 in buses, AUD $0.03 in light rail and AUD $0.09 in rail. However there is no information on willingness to pay for different information sources in the Australian context which this paper addresses in the modelling section.

3.5. Research gap and research questions

After analysing some of the existing literature on how people utilise information in travelling, it is clear that there is a lack of knowledge on how different sources of information influence travel decisions. The literature that exists tend to study multiple information sources separately in those circumstances where more than one information source is identified. By treating information as a single attribute, it does not highlight the differences between them, especially as the conclusions between studies are quite different which may be due to the differences in the source of information, to the other soft factors included in the survey (e.g. if it was compared to frequency which might induce a correlation), to respondents (e.g. regular users, infrequent users, etc.) or to the mode of transportation studied. Interestingly, the role of attitudes to public transport and travelling more generally is not linked to the literature on the usefulness or otherwise of information in travel. This paper addresses this gap by considering the difference between awareness and use of different information sources and also which information sources are relevant for travellers at different stages of their journey as well as relating the information provision and use to the mode of travel (which is absent in the literature).

The research questions to be addressed in this paper follow on from the research gaps identified.

1. Which information sources are travellers aware of and which of these are used?
2. How does awareness and use vary according to the intensity of public transport use?
3. Do the information sources used by public transport travellers change, according to public transport mode used?
4. How do the information sources vary according to the stage of the trip?
5. How does satisfaction of the provision of information sources and the overall public transport trip depend on journey purpose, socio demographics, information provision and use and attitudes?

These questions divide into two groups: Those which can be answered descriptively (questions 1-4) and question 5 which requires a modelling approach because of its increased complexity.

The next section outlines the approach taken in this paper to address the research questions and the methodology of the survey undertaken to measure how travellers are currently using public transport information.

4. The survey: its design and the respondents

The data source for the empirical part of this paper are from respondents to an on-line survey. Targeted respondents were given access to an on-line survey as described in Section 4.1. The literature review identities a number of under-researched areas. The questionnaire is designed to seek answers to the identified gaps. The analysis of the questionnaire will depend on the specific questions.

The sampling process, selection of respondents and descriptive statistics of the overall sample are provided in Section 4.2.

4.1. Design of survey

The questionnaire is designed to meet the research questions emerging from the research gaps identified in the literature review in Section 3. A questionnaire was developed for this purpose. After asking a question about access to different technologies (smartphone, tablet, laptop/desktop computer), the questionnaire was divided to put different questions to low users (“I do not use public transport if I can help it”), infrequent users (1 day or less per week) and regular users (2-3 days or more per week).

Questions to each of these groups followed a similar pattern but tailored where necessary for different usage levels. Generally the questions were similar for infrequent and regular users but required adjustment for circumstances for low-users. After questions about the modes used and the frequency of these modes, infrequent and regular users were asked questions on their most *recent* trip (infrequent users) and most *frequent* trip (regular users). Low users were asked questions in relation to an *unfamiliar* trip. The questions asked about awareness and use of different sources of information in general, and in the context of a change (a cancelled connection for infrequent users and a change in timetable for regular users). Respondents were also asked to identify the usefulness of different information sources in relation to different stages of the trip (pre-trip planning, whilst on the trip and on egress from the public transport stop). The different information sources are shown in Table 2.

Table 2: Information sources included in the questionnaire

|  |
| --- |
| Information source |
| An app (e.g. TripView, abil.io, TransitTimes, Arrivo) |
| Twitter or Facebook |
| Google Maps Transit |
| Printed timetable leaflet |
| Printed timetable at a bus stop, train station, tram stop or ferry wharf |
| Map of the transport network |
| Telephone information line (i.e. 131 500 in NSW) |
| Operator’s website (e.g.  sydneybuses.info) |
| Government website (e.g. transportnsw.info) |
| Word of mouth (i.e. I would ask a family member or someone I know) |

The questionnaire also contained a number of attitudinal questions. Perceptions of public transport and attitudes to different modes of transport have been found to play a significant role in travel behaviour research ([Handy et al., 2005](#_ENREF_2); [Mokhtarian et al., 2014](#_ENREF_3), [Aditjandra et al., 2016](#_ENREF_1))

Two further questions were asked about overall satisfaction of first, the information sources available for travel by public transport and second, of the public transport journey itself. The final section asked some socio-demographic questions (age, licence holding, occupation and education). The questionnaire was designed in Qualtrics, using the University of Sydney Business School branded version.

4.2. Selection of respondents and their characteristics

The data used in this paper were collected in June 2016, involving respondents residing in Greater Metropolitan area of Sydney. As described above, Sydney has a wide variety of information sources to help travellers undertake public transport journeys.

Participants were recruited using an online consumer panel *(*[www.lightspeedgmi.com](http://www.lightspeedgmi.com)). The final sample consisted of 554 respondents distributed over different age ranges and frequency of public transport use shown in Table 3. The average age of the sample was 49 (with a standard deviation of 14 years) which compares favourably to the average age of 46 for adult residents of the Greater Sydney Metropolitan area in 2011 (ABS 2013(2)). Initially the company over sampled older people and additional data was obtained for younger cohorts. There were more female respondents (59 per cent) than male; the proportion of females in the population is 52 per cent (ABS 2013(2)). For employment the biggest single group was full-time employed (31 per cent).

Within the sample, 79 per cent reported access to a smartphone and 94 per cent reported access to a computer. Pew Global Research (Poushter 2016) reports that 77 per cent of the Australian population has access to a smartphone and 93 per cent have access to the internet. The proportion of the sample who holds a drivers licence is 84 per cent almost equal to the Household Travel Survey’s estimate of 83 per cent (Raimond and Milthorpe 2010). Other characteristics of the final sample are presented in Table 3.

A quota was used to achieve roughly equal samples in each of the low-user, infrequent user and regular user of public transport. There is growing evidence that a consumer panel can deliver a representative sample if appropriate quota criteria are applied (see Hatton McDonald et al. (2010), Lindhjem and Navrud (2011)), and the panel used (GMI) will not undertake a project if there is a belief that the target sample is unachievable[[2]](#footnote-2). Section 5 addresses the descriptive analysis whilst Section 6 discusses the modelling results.

Table 3: Characteristics of the sample

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Unit | Sample | Population |
| Average age | years | 49 | 46 |
| Full driving licence | percentage | 84% | 83% |
| Gender |  |  |  |
| Female | percentage | 59% | 52% |
| Male | percentage | 41% | 48% |
| Access to |  |  |  |
| Smartphone | percentage | 79% | 77% |
| Tablet (e.g. Apple iPad) | percentage | 52% |  |
| Laptop or desktop computer | percentage | 94% |  |
| Car | percentage | 75% |  |
| Commuters | percentage of frequent users | 22% |  |
| Usage of public transport | | | |
| Low user | percentage | 35% |  |
| Infrequent user | percentage | 34% |  |
| Regular user | percentage | 31% |  |

5. Descriptive Analysis

5.1. How does awareness and use of information sources vary according to the intensity of use of public transport?

The full details of the information media which travellers are aware of and use are shown in Table 4. Chi-squared tests show that there are significant relationships between the intensity of use and the awareness of different information media (chi-squared test, p=0.00) and between intensity of use and use of different media (chi-squared test, p=0.00).

Table 4 clearly shows how frequent users are both more aware and higher users of apps in the Greater Sydney Metropolitan area. More surprisingly, because of the more esoteric nature of the information source, Twitter is more used by low users of public transport and that in this respect they are much more similar to regular public transport user. This picture is repeated with google map awareness and use. Telephone information, operator websites and government websites are much more likely to be used by low users of public transport than infrequent or regular users. In contrast infrequent or regular users are more likely to consult others (word of mouth) as an information source. These results are, of course aggregate results over all modes and all stages of the trip. The next two Sections unpack the results in terms of mode and trip stage.

Table 4: Awareness and use of different information media for a public transport trip by intensity of public transport use, measured as a percentage of respondents.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Low users of public transport for an unfamiliar trip | | Infrequent users of public transport for a recent trip | | Regular users of public transport for their regular trip | |
|  | Aware of info source % | Use of info source % | Aware of info source % | Use of info source % | Aware of info source % | Use of info source % |
| An app (e.g. TripView, abil.io, TransitTimes, Arrivo) | 32 | 18 | 45 | 21 | 62 | 34 |
| Twitter or Facebook | 51 | 34 | 31 | 10 | 46 | 21 |
| Google Maps Transit | 48 | 25 | 50 | 10 | 53 | 20 |
| Printed timetable leaflet | 52 | 28 | 60 | 22 | 58 | 28 |
| Printed timetable at a bus stop, train station, tram stop or ferry wharf | 36 | 14 | 43 | 7 | 43 | 12 |
| Map of the transport network | 34 | 12 | 41 | 7 | 49 | 8 |
| Telephone information line (i.e. 131 500) | 41 | 31 | 46 | 19 | 52 | 21 |
| Operator’s website (e.g. sydneybuses.info) | 50 | 36 | 54 | 21 | 56 | 26 |
| Government website (e.g. transportnsw.info) | 45 | 33 | 36 | 11 | 28 | 12 |
| Word of mouth (i.e. I would ask a family member or someone I know) | 17 | 6 | 10 | 20 | 8 | 13 |

5.2. How information source use varies according to main mode of travel

Regular users were categorised by the mode on which they spent the majority of their journey (main mode). The awareness of information media differed by mode (chi-squared test, χ2 = 23.18, p=0.003) as did the use of information media (chi-squared test, χ2 = 74.85, p = 000). Table 5 presents the results.

Table 5: The awareness and use of information media by regular users of public transport on their regular trip

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Regular users of public transport | | | |
|  | **Train main mode** | | **Bus main mode** | |
|  | Aware of info source | Use of info source | Aware of info source | Use of info source |
| An app (e.g. TripView, abil.io, TransitTimes, Arrivo) | 62 | 38 | 60 | 29 |
| Twitter or Facebook | 45 | 25 | 47 | 15 |
| Google Maps Transit | 52 | 21 | 54 | 19 |
| Printed timetable leaflet | 51 | 21 | 68 | 38 |
| Printed timetable at a bus stop, train station, tram stop or ferry wharf | 47 | 13 | 37 | 10 |
| Map of the transport network | 49 | 9 | 50 | 7 |
| Telephone information line (i.e. 131 500) | 50 | 23 | 53 | 19 |
| Operator’s website (e.g. sydneybuses.info) | 61 | 26 | 50 | 26 |
| Government website (e.g. transportnsw.info) | 31 | 13 | 25 | 12 |

Note: Word of mouth category deleted as frequency less than 5 people in the bus mode

Table 5 shows that whilst regular train and bus users have similar knowledge of apps, bus users are much more likely to be app users whereas the reverse is true for Twitter or Facebook users. Printed timetables are more used by bus users, probably because they are more available with train users being more aware of the operator website, maybe because there is only one operator for trains. Use of google transit is almost exactly the same for regular train and bus users as is the use of telephone and government website information.

5.3. How do information source use vary according to the stage of the trip?

The full details of how information media are used by low, infrequent and regular users of public transport at different stages of their public transport trip is shown in Table 6. Chi-square tests for each stage of the trip show significant differences between the proportions of information media use (Chi squared tests, χ2 = 104.29 p=0.00, χ2 = 157.56 p=0.00, χ2 = 98.77 p=0.00 for low, infrequent and regular uses respectively).

**Table 6: Percentage (%) of information source use by different intensity public transport users and different stages of an unfamiliar (low users), recent (infrequent), or regular (frequent) public transport trip**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Planning trip % use | | | Waiting at stop or station % use | | | During trip % use | | | Egress from trip % use | | |
|  | L | I | R | L | I | R | L | I | R | L | I | R |
| An app (e.g. TripView, abil.io, TransitTimes, Arrivo) | 10 | 21 | 28 | 8 | 17 | 31 | 10 | 19 | 32 | 8 | 19 | 28 |
| Twitter or Facebook | 15 | 7 | 12 | 6 | 4 | 6 | 7 | 2 | 11 | 10 | 9 | 12 |
| Google Maps Transit | 10 | 9 | 6 | 7 | 7 | 4 | 8 | 7 | 8 | 12 | 8 | 6 |
| Printed timetable leaflet | 4 | 8 | 6 | 39 | 45 | 34 | 12 | 7 | 9 | 7 | 9 | 7 |
| Printed timetable at a bus stop, train station, tram stop or ferry wharf | 2 | 1 | 3 | 5 | 3 | 2 | 7 | 9 | 3 | Not applicable | | |
| Map of the transport network | 5 | 1 | 2 | 3 | 1 | 2 | 2 | 1 | 4 | 5 | 5 | 8 |
| Telephone information line (i.e. 131500) | 16 | 21 | 14 | 4 | 4 | 4 | 7 | 10 | 4 | 9 | 5 | 8 |
| Operator’s website (e.g. sydneybuses.info) | 23 | 25 | 23 | 4 | 3 | 6 | 8 | 5 | 6 | 9 | 8 | 4 |
| Government website (e.g. transportnsw.info) | 14 | 4 | 6 | 23 | 13 | 12 | 38 | 37 | 22 | 36 | 35 | 26 |

Notes: L=low user; I= infrequent user and R = regular user; low users were asked for their information usage if they were faced with an ‘unfamiliar trip’, infrequent users were asked about a recent trip and frequent users were asked about their regular trip.

As can be seen from Table 6, in planning a journey, there appears to be big differences in use by intensity of use for app use and for government website use. For apps, low users are significantly less likely to use an app than regular users. Infrequent users appear more than twice as likely to use an app as low users. Another big difference is in the use of the telephone information line with low users being a higher user than infrequent and regular users (in that order).

Information sources used whilst waiting at stop or station is predominately the printed timetable leaflet: this in some ways will be disappointing to operators who are hoping to become paper free. The Government website is the next most used with marked differences for use between low public transport users and all others. A similar but reverse pattern can be seen for the use of an app whilst waiting at a stop or station. Here low users are significantly less likely to use an app. This maybe because of the investment in time (in particular) to download and learn to use apps for public transport when one, as infrequent users are, not particularly interested in using public transport.

Similar patterns can be seen with information sources used on egress from the public transport system to access the destination. Apps are used much more and the Government website much less than low public transport users whereas the reverse is true for google maps transit and the government website.

6. Factor analysis

Travel attitudes and preferences to cars, driving, public transport and active transport were measured using 22 statements very loosely based on [Handy et al. (2005](#_ENREF_2)). The statements were measured using a five-point scale from “strongly disagree” to “strongly agree”. Factor analysis to provide latent constructs which are subsequently used as continuous variables in the modelling. Factor Analysis with oblique rotation was used as a first step to identify the latent constructs underlying the 22 statements on travel attitudes/preferences. An oblique (Oblimin) rather than orthogonal rotation was used because, in theory, the latent factors of attitudes and preferences and travel attitudes might correlate with each other and would not be statistically independent (Field, 2005). The criterion “Eigenvalue > 1” was used to determine the number of factors together with the scree plot (shown in Figure 2) that graphs the Eigenvalue against the factor number. Looking at the slopes we decided to proceed with five factors: public transport and walking lovers; bicycle lovers; time minimisers (people who care less about the mode of travel but care about travel time); car lovers; and car users (people that use the car but do not necessarily like driving). Each of the factors considered represents at least 10 per cent of the variance for the respected model. Factor loadings larger than 0.3 are shown in Table 7. Large factor loadings means the factor identified is significantly influenced by that factor. If they are small then the factor identified is not influenced by that factor. Table 7 shows the ones considered as medium to highly influential. These factors (latent constructs) are then treated as observed continuous variables, in the development of the model.

Figure 2: Scree Plot for Travel Attitudes’ Factors SPSS

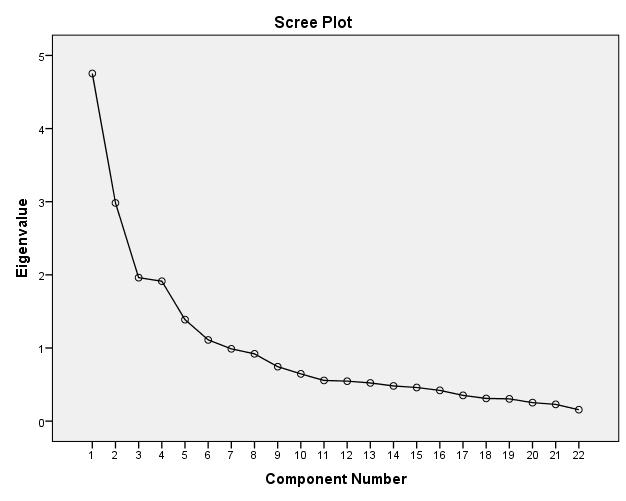


Table 7: Factors capturing the travel attitudes and preferences of respondents

|  |  |  |
| --- | --- | --- |
| Travel attitude/ preference factor | Statements | Loadings |
| 1. Public transport and walking lover | Travelling by car is safer overall than taking public transport | -0.322 |
| I prefer to walk rather than drive whenever possible | 0.786 |
| Walking can sometimes be easier for me than driving | 0.746 |
| I prefer to take public transport rather than drive whenever possible | 0.615 |
| I like walking | 0.800 |
| Public transport can sometimes be easier for me than driving | 0.637 |
| Travelling by car is safer overall than walking | -0.300 |
| I like taking public transport | 0.598 |
| Public transport operators should provide free wifi to passengers | 0.319 |
| 2. Bicycle lovers | Travelling by car is safer overall than riding a bicycle | -0.517 |
| To me, the car is a status symbol | 0.399 |
| I like riding a bike | 0.809 |
| I prefer to ride a bike rather than drive whenever possible | 0.914 |
| Riding a bike can sometimes be easier for me than driving | 0.895 |
| 3. Time minimisers | Travelling by car is safer overall than taking public transport | 0.381 |
| Travel time is generally wasted time | 0.751 |
| The only good thing about travelling is arriving at your destination | 0.610 |
| Getting there is half the fun | -0.532 |
| I like taking public transport | -0.452 |
| 4. Car lovers | Travelling by car is safer overall than taking public transport | 0.371 |
| Travelling by car is safer overall than riding a bicycle | 0.440 |
| I like driving | 0.780 |
| To me, the car is a status symbol | 0.394 |
| Travelling by car is safer overall than walking | 0.412 |
| Getting there is half the fun | 0.519 |
| I like to drive just for fun | 0.745 |
| I feel free and independent if I drive | 0.751 |
| 5. Car users | It does not matter to me which type of car I drive | 0.795 |
| Travelling by car is safer overall than walking | 0.324 |
| To me, the car is nothing more than a convenient way to get around | 0.745 |

7. Modelling

Two choices (dependent variables) were considered in this study: a self-reported measure of overall satisfaction with the public transport trip; and a self-reported measure of overall satisfaction in the provision of information sources for travel by public transport. Responses were given on a five-point scale from “extremely satisfied” to “extremely dissatisfied”, so the analysis must consider that these choices are between ordered discrete alternatives. The ordered choice model was first developed by Mckelvey and Zavoina (1975) for the analysis of non-quantitative, ordinal and discrete dependent variables. Its base in the random utility model that assumes that:

 (1)

 (2)

where Y is the dependent variable, X the independent variables,  is the vector of unknown parameters, and  an error term that has a multivariate normal distribution with mean 0 and variance . The continuous latent utility, Y, is transformed into a categorical variable Z with M response categories R1, … RM, through the unobserved variable. It assumes there are M+1 extended real numbers  as follows:

= , = (3)

 (4)

Where

 (5)

Due to identification issues the model assumes that = 0 (the author is referred to Mckelvey and Zavoina (1975) for more details). This model is estimated using the maximum likelihood function, which is commonly used in discrete choice modelling. The ordered logit model assumes a standardized logistic distribution for the error term with mean of 0 and variance of , and the ordered probit model assumes a standard normal distribution. Both models were explored in this study, with an ordered logit model providing the better fit. Alternative model specifications were also investigated, including random parameters both in the independent variables and in the thresholds, but were not a better fit.

As part of the explanatory variables we considered the travel attitudes and preferences’ factors shown in Table 7, some socioeconomic demographics, and the information sources that individuals used in their recent/regular trip and cancelled/changed trip. Even though all respondents were asked which information sources they used and were aware of in the two different situations (a normal and an altered situation), the responses of low users have been excluded from the analysis since their understanding of the full range of available information sources could be considered unreliable due to the lack of experience.

8. Results

Eight models were developed and are presented in Table 8. All the observations collected (for low users, infrequent and frequent) were included in the models as all these user groups responded in terms of their satisfaction but, as mentioned above, the information sources’ parameters are only included for frequent and infrequent users. Low users lack of experience in public transport translated into a lack of experience on the different information sources and most of their responses regarding these attributes were left blank. As a result, low users are represented by the socioeconomic characteristics and the alternative specific constant in the models. Our four final models (Table 8) present the results combining the responses for frequent and infrequent users. The dependent variable in the first two columns of each table is the self-reported measure of overall satisfaction with the public transport trip; and in the third and fourth column the dependent variable is the measure of the overall satisfaction in the provision of information sources for travel by public transport. In each table there are different models for the regular/recent trips and for the trips which were changed/cancelled.

As expected travel attitudes identifying car lovers and car users (see Table 7) did not show to be significant in any of the models and are not included in models shown in, the threshold values represent the value of switching between two adjacent levels of satisfaction values in the utility: the mean estimates are significant in both models. The value of the AIC indicator is better (lower) when considering the cancelled or changed trip as compared to its value on the recent or regular trip suggesting that the information sources used during the cancelled or changed trips represent better the overall satisfaction on with the public transport trip.

The coefficients are ordered log-odds and their interpretation is that for a one unit increase in the explanatory variable, the overall satisfaction would change according to the coefficient estimate. So, for a regular/recent trip, ceteris paribus, the ordered logit for commuters being in a higher category of overall satisfaction with public transport is less (because the coefficient is negative) than non-commuters (the base case) and is exactly 0.0004 less when we consider estimates for the models shown in the first column of Table 8). Regarding the travel attitudes, in all the models travel time minimisers are less satisfied both with the overall trip and with the information sources provided compared to public transport and walking or bicycle lovers. Moreover, results show that bicycle lovers are overall more satisfied than public transport and walking lovers. For example, using the model that considers recent/regular trip (first column Table 8), a one unit increase in the bicycle lover attitude would significantly increase the overall satisfaction with public transport in 0.601, ceteris paribus.

The results show that individuals younger than 30 years old are more likely to be satisfied with their public transport trip and with the information sources provided, with the opposite for people 40 years old or older. The gender of individuals is not significant when considering the overall satisfaction with public transport but is significant when considering satisfaction with information sources with results showing men are less likely to be satisfied than women. The results also show that commuters are less likely to be satisfied with their overall public transport trip and, in only one of the models, they seem to be less likely to be satisfied with the information sources available. The services with higher frequency seem to positively influence the level of satisfaction with the information sources provided which is to be expected since there is less need for information on a service that has high frequency. However, high frequency did not show as significant on satisfaction on the overall public transport trip which is contrary to expectations.

Table 8: Results for the models considering common information sources for frequent and infrequent users

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Satisfaction with public transport | | Satisfaction with information sources | |
| Regular/ Recent Trips | Changed/ cancelled trips | Regular/ recent trips | Changed/ cancelled trips |
| Parameters | Mean (t test) | Mean (t test) | Mean (t test) | Mean (t test) |
| ASC | 3.704 (17.7)\*\*\* | 3.559 (17.0)\*\*\* | 4.360 (24.3)\*\*\* | 3.925 (16.4)\*\*\* |
| Main purpose - commuter | -0.0004 (1.9)\* | -0.0004 (-2.0)\*\* | - | -0.0004 (-1.5)\* |
| High Frequency (headway < 15 min) | - | - | - | 0.523 (1.5)\* |
| Age younger than 30 years | 0.200 (1.5)\* | 0.210 (1.6)\* | 0.209 (1.6)\* | 0.235 (1.8)\* |
| Age 40 years or older | -0.199 (1.5)\* | -0.209 (1.5)\* | -0.207 (1.6)\* | -0.233 (1.7)\* |
| Gender male | - | - | -0.002 (1.8)\* | -0.002 (1.8)\* |
| Travel Attitude: Public transport and walking lover | -0.196 (2.1)\*\* | -0.208 (2.2)\*\* | -0.191 (2.0)\*\* | -0.194 (2.0)\*\* |
| Travel Attitude: Bicycle lover | 0.601 (6.4)\*\*\* | 0.613 (6.5)\*\*\* | 0.579 (6.5)\*\*\* | 0.591 (6.2)\*\*\* |
| Travel Attitude: Time minimisers | -0.776 (8.7)\*\*\* | -0.772 (8.7)\*\*\* | -0.543 (6.0)\*\*\* | -0.545 (6.0)\*\*\* |
| An app | 0.322 (1.6)\* | 0.222 (1.1) | 0.556 (2.8)\*\*\* | 0.539 (2.8)\*\*\* |
| Google Maps Transit | -0.078 (0.3) | -0.078 (0.3) | 0.129 (0.6) | -0.036 (0.1) |
| Printed timetable leaflet | -0.188 (0.8) | -0.063 (0.2) | 0.195 (0.8) | 0.037 (0.2) |
| Printed timetable at a stop or station | 0.008 (0.0) | 0.057 (0.3) | -0.102 (0.4) | 0.228 (1.2) |
| Map of the transport network | -0.179 (0.6) | -0.384 (1.4)\* | -0.594 (2.0)\*\* | -0.305 (1.0) |
| Telephone information line | -0.434 (1.4)\* | -0.176 (0.7) | -0.028 (0.0) | -0.020 (0.0) |
| Operator’s website | -0.142 (0.7) | 0.311 (1.5)\* | 0.113 (0.6) | 0.452 (2.1)\*\* |
| Government website | -0.058 (0.3) | -0.132 (0.6) | 0.297 (1.5)\* | 0.153 (0.74) |
| Word of mouth | 0.055 (0.3) | 0.123 (0.6) | -0.011 (0.0) | 0.043 (0.19) |
| Twitter or Facebook | -0.486 (1.7)\* | -0.093 (0.2) | -0.569 (2.0)\*\* | -0.253 (0.7) |
| Threshold Mu(01)| | 1.588 (13.4)\*\*\* | 1.593 (13.4)\*\*\* | 1.265 (8.0) \*\*\* | 1.270 (8.1)\*\*\* |
| Threshold Mu(02)| | 3.189 (30.5)\*\*\* | 3.192 (30.6)\*\*\* | 3.606 (31.1)\*\*\* | 3.600 (31.2)\*\*\* |
| Threshold Mu(03)| | 5.796 (38.5)\*\*\* | 5.776 (38.8)\*\*\* | 6.125 (43.4)\*\*\* | 6.107 (43.4)\*\*\* |
| Log likelihood | **-662.9** | **-665.4** | **-611.5** | **-612.7** |
| # estimated parameters | **20** | **20** | **20** | **22** |
| AIC | **2.511** | **2.520** | **2.322** | **2.334** |

\*, \*\*,\*\*\* denotes a confidence level of 80%, 95% and 99% respectively

The survey offered respondents ten different types of information sources to see which ones are the most relevant ones when analysing users’ satisfaction. These are directly included in the models without any grouping. However, as Table 8 shows, only a few information are relevant in each model. We estimated the same four models shown in Table 8 but separating the information sources used by users and non-users with similar general results but some differences in the information sources that seem to be relevant. A summary of the information sources that had a statistically significantly impact on satisfaction are summarised in Table 9 (considering a confidence level of 80%) for frequent and infrequent users combined, and for each of them separately. This shows that there are differences between the information sources relevant for frequent and infrequent users, and also when frequent and infrequent user respondents are combined.

It is important to note the different interpretation given by the two different dependent variables. When looking at the overall satisfaction with the public transport trip the model is explaining this variable by the information sources that individuals actually use. Hence, the interpretation is that people who use and are aware of those information sources are less/more likely to be satisfied with their overall public transport trip. Table 9 shows that users who use apps are usually more satisfied with their recent/regular trips, but users are likely to have a lower level of satisfaction in their recent/regular trips, relative to other users if they use Twitter or Facebook. The results changed considerably when studying the changed/cancelled trips, where the only ones that seem to be significant are: the users who use operators’ website with a positive influence and the users who use network map with a negative influence.

In the second dependent variable (third and fourth column of Table 8), the level of satisfaction is being explained by reference to the information sources provided in comparison with the information sources that individuals actually use. These results show which information sources produce higher satisfaction levels. Table 9 shows a higher level of satisfaction towards apps, and also towards the government website but a lower satisfaction level towards network maps and twitter/fb. For changed/cancelled trips there is a high satisfaction level towards apps and the operators’ website.

Table 9: Summary of significant relevant information sources (80% confidence level)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Frequent and infrequent users combined | Frequent users | Infrequent users |
| **Overall satisfaction with public transport** | **Recent or regular trip** | App +  Phone line –  Twitter/Fb – | App + | App +  Printed timetable leaflet +  GoogleMaps - |
| **Changed or cancelled trip** | Operator web +  Network map - | App + | None |
| **Satisfaction with information sources provided** | **Recent or regular trip** | App +  Government web +  Network map –  Twitter/Fb - | App +  Government web + | App +  Printed timetable leaflet + |
| **Changed or cancelled trip** | App +  Operator web + | App +  Operator web +  Government web +  Phone line - | None |

Notes: + and - signs represent the positive and negative influence that the information source had on satisfaction.

Comparing the combined and separate results for frequent and infrequent users, it is interesting to note that the printed timetable leaflet never seem to be relevant for frequent users but it did for infrequent users. The opposite was true for operator and government websites, which was sometimes relevant for frequent users but never for infrequent. These results allow us to determine the target users for these information sources.

In summary, in terms of answering the research gaps, it is clear that overall satisfaction of the public transport trip and overall satisfaction of information for public transport trips are dependent on the attitude of the respondent. Age appears to be a significant factor in influencing the overall satisfaction of both dependent variables, and gender only on the satisfaction with information sources provided. A high frequency also influences positively the satisfaction with information sources provided. The apps showed to be one of the most important information sources towards both satisfaction levels for frequent and infrequent users. For the satisfaction on information sources, the websites also showed to be significant for these type of users.

9. Conclusions and areas for further research

This research has looked at the relationship between availability and use of information sources and overall satisfaction with information provision and overall satisfaction with public transportation in general. In particular the descriptive statistics confirmed that frequent users are both more aware and higher users of apps in the Greater Sydney Metropolitan area but with Twitter being used by low users of public transport. Infrequent and regular users are more likely to consult others (word of mouth) rather than official information sources. Significant differences occur between bus and train users in relation to printed timetables with printed timetables being more used by bus users. Users also identified different information needs at different stages of the journey.

The modelling results show that there are a few differences between frequent and infrequent users. The apps are one of the main information sources that influence traveller’s levels of satisfaction with the public transport trip and also with the information sources provided, infrequent users are also influences by printed timetable leaflets and frequent users by the government and operators’ websites. The modelling confirmed the role of attitudes in framing the respondent’s identification of their satisfaction with the overall public transport trip and with the information sources provided.

Together, the descriptive statistics and the modelling are important first steps towards improving our understanding of how information availability influences people’s choice of mode of transport and how this is changing with the changing forms in which travellers can seek information. Further research to understand this in more depth requires including the views of the non-commuter – a hard to find respondent in Greater Sydney where overall public transport use is in single digits. Furthermore, the research here suggests that where variables relating to the quality of information are included in future studies, they should be included in a disaggregate fashion rather than as a single ‘information provision’ variable.

There are several policy implications from this work. Firstly, the research suggests that the type of information preferred by travellers varies by public transport mode and varies by trip segment. Secondly, the role of attitudes must be a factor in information provision, just as it is with other travel behaviour implementation.

Transport for NSW’s open data policy and release of real time information to app developers seems to have been successful with the results shown in Table 4 suggesting that this is obviously well used by infrequent and regular users. Moreover, this is supported by the modelling where apps have a positive impact on satisfaction. However, increasing the use of apps or online travel planners by low users perhaps should be a strategy of transport planning as this is a convenient way of targeting information where it is needed most. The large proportion of people with access to smart phones and/or online travel planners and the uptake of apps and online travel planners suggest that there is a case for the continued phase out of printed timetables. However, on equity grounds, provision should still be made for those people without smart phones.

Finally, it is suggested that this research should be revisited in the future as the current changes information provision and usage play out over time.

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1. They assume that public transport information systems are of most interest to travellers who are not very familiar with the network. [↑](#footnote-ref-1)
2. GMI provide statistics as to their panel comparison with census information at <http://www.lightspeedgmi.com/wp-content/uploads/2015/01/LightspeedGMI_PanelBook_2015_online.pdf> [↑](#footnote-ref-2)